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Smallholder farmer perceived effects of climate change on agricultural productivity and adaptation strategies

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ABSTRACT

The agriculture sector is sensitive to climate change and the capacity of smallholder farmers in developing countries to adapt is limited. Similar to adoption of any development-oriented strategies, perception is prerequisite to successful adaptation of agricultural strategies against climate change effects. This study was conducted in the semi-arid Lower Gweru Communal area of Central Zimbabwe to sensitize smallholder farmers on climate change and to establish their perceptions of the projected climate of Zimbabwe by 2050. Data were collected during 2011 from a total of 60 farmers drawn from six villages in Mdubiwa and Nyama Wards. Farmers were selected using systematic random sampling from a households list and grouped into three wealth groups: resource rich; resource poor and intermediate. Focus Group Discussions were conducted with each group to investigate their perceptions of the projected climate by 2050 and their proposed adaptive strategies. Farmers perceived the projected climate to have negative effects on their livelihoods and there were no outstanding differences in the nature of responses across the three categories of farmers. Farmers' responses showed that they were concerned about crop and livestock productivity as well as availability of water resources, food and nutrition security and about their general well-being. The intermediate wealth group, which had more than half of its members above 70 years of age provided the least number of ideas for adaptations. Farmers also suggested how they could possibly counteract some of the predicted negative effects or maximize on positive effects. Strategies that were suggested by the farmers were largely concerned with cropping and tended to address water shortages. It was concluded that almost all strategies suggested by farmers were self-directed, rather than directed at authorities like government or donors to do something for them thus showing that farmers had the will power to deal with climate change themselves.

1. Introduction

Climate change is a topical subject worldwide and there is evidence that this phenomenon is taking place (Solomon et al., 2007). Agriculture is one of the sectors most affected by climate change. Several research work has been conducted to try to establish the effects of climate change on agriculture. Climate change may be beneficial to agriculture, depending on geographical region. However, for the lower latitude areas, climate change is projected to result in increased temperature, reduced rainfall and increased frequency of extreme weather events such as floods and droughts. Thus, rainfed agriculture will be negatively impacted. In Africa, crop yields have been projected to decrease (e.g. Parry et al., 2007; Schlenker and Lobell, 2010). In this region, the majority of the population are smallholder farmers who rely on rainfed agriculture for their livelihoods. Rainfed agriculture is the predominant farming system in Sub-Saharan Africa where approximately 90% of cereal production is from rainfed agriculture (Rosegrant et al., 2002).

Due to their heavy reliance on rainfed agriculture, climate change will increase vulnerability of the rural populations due to food and nutrition insecurity. Communities in most developing countries, particularly those in Africa have been identified as being the most vulnerable to climate change because of multiple stressors and reduced adaptive capacity (Parry et al., 2007; Gandure et al., 2013). It is

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therefore imperative that farmers adapt to climate change and variability to reduce its negative impacts on their livelihoods. Maddison (2007) reckons that perception is pre-requisite to adaptation, implying that before communities can effectively embark on climate change adaptation strategies, they must be aware and appreciative of the potential effects that this phenomenon may have on their livelihoods. Profound community perceptions on climate variability and change have been established across Africa including in Southern Africa (Mubaya et al., 2012; Gandure et al., 2013) and in East and North Africa (Maddison, 2007). However, not all farmers perceive such changes and not all perceptions are true or match climate records. Thus, it is essential to inform community stakeholders such as farmers, of projected climate change.

In Zimbabwe approximately 90% of land cultivated by smallholder farmers is located in already marginal rural areas (Natural Regions III–V) (FAO, 2006), with respect to rainfall amount and distribution as well as soil fertility. Hence, climate change will most likely worsen their situation. The objectives of this study were to i) conscientise smallholder farmers in Lower Gweru Communal area of Zimbabwe on climate change and its potential effects on crop productivity ii) establish farmers' perceived effects of the projected climate by 2050 and iii) capture their proposed strategies to reduce possible negative impacts or maximize on possible positive impacts of climate change.

2. Materials and methods

2.1. Study area

Lower Gweru is a developed communal settlement in the Midlands province of Zimbabwe. It is located about 40 km north west of the City of Gweru, and stretches a further 50 km to the West. Two Wards namely Mdubiwa and Nyama in Lower Gweru communal area (Fig. 1) were selected for the study. The communal area falls in Natural Region (Agro-ecological Zone) IV of Zimbabwe, which is generally described as semi-arid to arid and receives rainfall from October to April ranging from 450 mm to 600 mm annually, with frequent droughts. The rainfall season is characterized by periodic seasonal droughts and severe dry spells (Vincent and Thomas, 1978 as cited in Masere and Worth, 2015). Temperatures are generally high, with annual mean maximum temperatures ranging from 32 to 35 °C. The high temperatures render rainfall received less effective due to high evaporative losses. Soils in Lower Gweru Communal area are generally shallow, coarse-grained sands, which have a low production potential (Thompson and Purves, 1978 as cited in Makuvaro et al., 2014).

Most of the Lower Gweru communal farmers own very small farms ranging from 0.5 ha to 2.4 ha (Masere, 2014). However, most farmers were cultivating only portions or few of their fields due to lack of adequate inputs (fertilizers and hybrid seeds), high frequency of below-normal rainfall seasons, poor soils and labour constraints (Makuvaro et al., 2014; Masere, 2014). Main crops grown include cereals (maize [*Zea mays*], sorghum [*Sorghum bicolor*], Finger millet [*Eleusine coracana*]), legumes (groundnuts [*Arachis hypogea*], sugar beans [*Phaseolus vulgaris*], cowpeas [*Vigna unguculata*], Bambara groundnuts [*Vigna subterranea*]), tuber crops (Irish potatoes [*Solanum tuberosum*], sweet potatoes [*Ipomoea batatus*]), fruits and vegetables (Makuvaro et al., 2014; Masere, 2015). The two main purposes of growing crops are household consumption and income generation. The other reason is stock (cattle and poultry) feeding. Legumes are also grown for improving the soil nutrient status due to their ability to fix atmospheric nitrogen into the soil (Masere, 2015).

Lower Gweru farmers have limited livestock with the majority (about 70%) owning between one to five cattle (Masere, 2015). Similar ownership patterns were also reported for small livestock (goats and poultry). Cattle are very useful as a source of draft power for various field operations and for food. Conversely, goats are usually used as a form of insurance for income and can be disposed of quickly in the

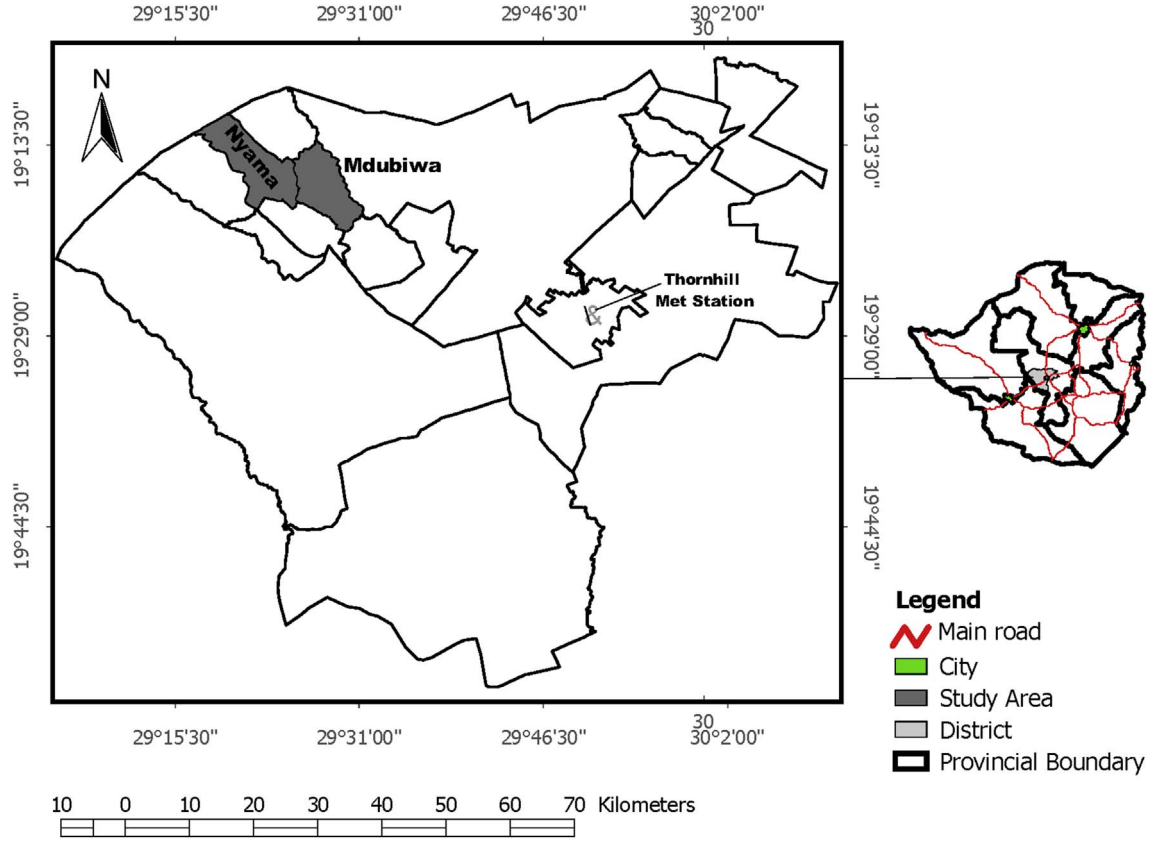

Fig. 1. Map showing location of study area and Thornhill meteorological station whose data were used in simulating climate change effects on maize growth and yield.